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Such are the points which I propose to examine in the next place ; in the mean time the observations I have just alluded to are a proof that bodies can absorb a certain amount of heat not indicated by the thermometer (which becomes *latent*), and that this is effected *without the body undergoing a change of state*; secondly, that they slowly part with this heat again until they have acquired their original densities ; thirdly, so many different substances being affected by a change of density when melted or simply heated to redness and allowed to cool, it is probable this property will be found to belong, more or less, to all substances without exception.

II. "On the Spectra of some of the Fixed Stars." By W. HUGGINS, F.R.A.S., and WILLIAM A. MILLER, M.D., LL.D., Treasurer & V.P.R.S., Professor of Chemistry, King's College, London. Received April 28, 1864.

(Abstract.)

After a few introductory remarks, the authors describe the apparatus which they employ, and their general method of observing the spectra of the fixed stars and planets. The spectroscope contrived for these inquiries was attached to the eye end of a refracting telescope of 10 feet focal length, with an 8-inch achromatic object-glass, the whole mounted equatorially and carried by a clock-movement. In the construction of the spectroscope, a plano-convex cylindrical lens, of 14 inches focal length, was employed to convert the image of the star into a narrow line of light, which was made to fall upon a very fine slit, behind which was placed an achromatic collimating lens. The dispersing portion of the arrangement consisted of two dense flint-glass prisms ; and the spectrum was viewed through a small achromatic telescope with a magnifying power of between 5 and 6 diameters. Angular measures of the different parts of the spectrum were obtained by means of a micrometric screw, by which the position of the small telescope was regulated. A reflecting prism was placed over one half of the slit of the spectroscope, and by means of a mirror, suitably adjusted, the spectra of comparison were viewed simultaneously with the stellar spectra. This light was usually obtained from the induction spark taken between electrodes of different metals. The dispersive power of the apparatus was sufficient to enable the observer to see the line *Ni* of Kirchhoff between the two solar lines *D* ; and the three constituents of the magnesium group at *b* are divided still more evidently \*. Minute

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considerable time. The *increase* of density of Gadolinite and the *decrease* of density of Samarskite by the action of heat are accompanied by a vivid emission of light, as mentioned in my work on 'Phosphorescence' &c., pp. 31 and 32, where H. Rose's ingenious experiment is described.

\* Each unit of the scale adopted was about equal to  $\frac{1}{1800}$ th of the distance between *A* and *H* in the solar spectrum. The measures on different occasions of the same line rarely differed by one of these units, and were often identical.

details of the methods adopted for testing the exact coincidence of the corresponding metallic lines with those of the solar and lunar spectrum, are given, and the authors then proceed to give the results of their observations.

Careful examination of the spectrum of the light obtained from various points of the moon's surface failed to show any lines resembling those due to the earth's atmosphere. The planets Venus, Mars, Jupiter, and Saturn were also examined for atmospheric lines, but none such could be discovered, though the characteristic aspect of the solar spectrum was recognized in each case; and several of the principal lines were measured, and found to be exactly coincident with the solar lines.

Between forty and fifty of the fixed stars have been more or less completely examined; and tables of the measures of about 90 lines in Aldebaran, nearly 80 in  $\alpha$  Orionis, and 15 in  $\beta$  Pegasi are given, with diagrams of the lines in the two stars first named. These diagrams include the results of the comparison of the spectra of various terrestrial elements with those of the star. In the spectrum of Aldebaran coincidence with nine of the elementary bodies were observed, viz. sodium, magnesium, hydrogen, calcium, iron, bismuth, tellurium, antimony, and mercury; in seven other cases no coincidence was found to occur.

In the spectrum of  $\alpha$  Orionis five cases of coincidence were found, viz. sodium, magnesium, calcium, iron, and bismuth, whilst in the case of ten other metals no coincidence with the lines of this stellar spectrum was found.

$\beta$  Pegasi furnished a spectrum closely resembling that of  $\alpha$  Orionis in appearance, but much weaker: only a few of the lines admitted of accurate measurement, for want of light; but the coincidence of sodium and magnesium was ascertained; that of barium, iron, and manganese was doubtful. Four other elements were found not to be coincident. In particular, it was noticed that the lines C and F, corresponding to hydrogen, which are present in nearly all the stars, are wanting in  $\alpha$  Orionis and  $\beta$  Pegasi.

The investigation of the stars which follow is less complete, and no details of measurement are given, though several points of much interest have been ascertained.

*Sirius* gave a spectrum containing five strong lines, and numerous finer lines. The occurrence of sodium, magnesium, hydrogen, and probably of iron, was shown by coincidence of certain lines in the spectra of these metals with those in the star. In  *$\alpha$  Lyrae* the occurrence of sodium, magnesium, and hydrogen was also shown by the same means. In *Capella* sodium was shown, and about twenty of the lines in the star were measured. In *Arcturus* the authors have measured about thirty lines, and have observed the coincidence of the sodium line with a double line in the star-spectrum. In *Pollux* they obtained evidence of the presence of sodium,

magnesium, and probably of iron. The presence of sodium was also indicated in *Procyon* and  $\alpha$  *Cygni*.

In no single instance have the authors ever observed a star-spectrum in which lines were not discernible, if the light were sufficiently intense, and the atmosphere favourable. Rigel, for instance, which some authors state to be free from lines, is filled with a multitude of fine lines.

Photographs of the spectra of Sirius and Capella were taken upon collodion; but though tolerably sharp, the apparatus employed was not sufficiently perfect to afford any indication of lines in the photograph.

In the concluding portion of their paper, the authors apply the facts observed to an explanation of the colours of the stars. They consider that the difference of colour is to be sought in the difference of the constitution of the investing stellar atmospheres, which act by absorbing particular portions of the light emitted by the incandescent solid or liquid photosphere, the light of which in each case they suppose to be the same in quality originally, as it seems to be independent of the chemical nature of its constituents, so far as observation of the various solid and liquid elementary bodies, when rendered incandescent by terrestrial means, appears to indicate.

III. "A Second Memoir on Skew Surfaces, otherwise Scrolls." By  
A. CAYLEY, Esq., F.R.S. Received April 29, 1864.

(Abstract.)

The principal object of the present memoir is to establish the different kinds of skew surfaces of the fourth order, or Quartic Scrolls; but, as preliminary thereto, there are some general researches connected with those in my former memoir "On Skew Surfaces, otherwise Scrolls" (Phil. Trans. vol. 153. 1863, pp. 453, 483), and I also reproduce the theory (which may be considered as a known one) of cubic scrolls; there are also some concluding remarks which relate to the general theory. As regards quartic scrolls, I remark that M. Chasles, in a footnote to his paper, "Description des Courbes de tous les ordres situées sur les surfaces réglées du troisième et du quatrième ordres," Comptes Rendus, t. liii. (1861), see p. 888, states, "les surfaces réglées du quatrième ordre . . . admettent *quatorze* espèces." This does not agree with my results, since I find only eight species of quartic scrolls; the developable surface or "torse" is perhaps included as a "surface réglée;" but as there is only one species of quartic torse, the deficiency is not to be thus accounted for. My enumeration appears to me complete, but it is possible that there are subforms which M. Chasles has reckoned as distinct species.